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Original Research Article

A Study on the Occurrence of Left Ventricular Diastolic Dysfunction in Subclinical Hypothyroidism

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Abstract:

Background: Subclinical hypothyroidism (SCH), defined by elevated thyroid-stimulating hormone (TSH) levels with normal free thyroxine (FT4), is a common endocrine disorder. Although asymptomatic, SCH is increasingly recognized for its impact on cardiovascular health, particularly its Correlation with left ventricular diastolic dysfunction (LVDD), a precursor to heart failure with preserved ejection fraction.

Aim: To assessing the incidence and severity of left ventricular diastolic dysfunction in patients with subclinical hypothyroidism and examining the correlation between TSH levels and diastolic function echocardiographic measures.

Methods: A retrospective observational study was conducted at Rajarajeswari Medical College and Hospital, Bangalore, over two years. Medical records of 100 patients aged ≥18 years diagnosed with SCH were reviewed. Patients with known cardiac, renal, or systemic disorders were excluded. Demographic data, thyroid profiles, and echocardiographic findings were analyzed. Diastolic dysfunction was graded based on ASE guidelines. SPSS version 23.0 was used to conduct the statistical analysis.

Results: Of the 100 patients, 42% had evidence of LVDD (68% female, mean age 47.6 ± 11.2 years). 31%, 9%, and 2% of these individuals had Grade I, Grade II, and Grade III dysfunction, respectively. Diastolic dysfunction patients had a substantially higher mean TSH level (9.2 ± 2.1 mIU/L) than those with normal diastolic function (6.8 ± 1.4 mIU/L, $p < 0.001$). LVDD was substantially correlated with altered echocardiographic parameters (E/A ratio, E/e' ratio, LAVI, and deceleration time).

Conclusion: A substantial proportion of patients with SCH demonstrated early signs of diastolic dysfunction, with higher TSH levels correlating with worsening diastolic function. These findings suggest that even mild thyroid dysfunction can affect myocardial relaxation.

Recommendations: Routine cardiovascular screening, including echocardiography, may be warranted in patients with SCH to facilitate early identification of diastolic dysfunction. Longitudinal studies are recommended to explore the impact of thyroxine therapy on cardiac outcomes in this population.

Keywords: Subclinical Hypothyroidism, Diastolic Dysfunction, Echocardiography, TSH Levels, Cardiovascular Risk.

Introduction

(SCH) is a biochemical disorder that is typified by normal circulating (FT4) concentrations and increased (TSH) levels, frequently without any clinical symptoms. It is a prevalent thyroid condition that affects 4% to 10% of people worldwide and can affect up to 20% of older women [1]. SCH is asymptomatic, but because of its modest yet profound impact on several organ systems, especially the cardiovascular system, it has attracted more and more attention.

Heart rate, myocardial contractility, systemic vascular resistance, and endothelial function are all aspects of cardiovascular homeostasis that are significantly influenced by thyroid hormones. Diastolic dysfunction, endothelial damage, and elevated cardiovascular risk have all been linked to even slight changes in thyroid hormone levels, as observed in SCH [2]. (LVDD) is one of the earliest detectable abnormalities in cardiac function associated with thyroid dysregulation. If

undiagnosed, it can lead to heart failure with preserved ejection fraction (HFpEF), which is characterized by increased filling pressures and impaired myocardial relaxation [3].

Several recent studies have demonstrated a higher occurrence of subclinical myocardial dysfunction in patients with SCH, particularly diastolic dysfunction, even when there are no obvious signs of structural heart disease. A study by Sinha et al. reported that 36% of patients with SCH exhibited echocardiographic evidence of Grade I LVDD, reinforcing the potential link between thyroid insufficiency and early cardiac remodeling [4]. Another study by Chinnappa et al. highlighted the positive correlation between TSH levels and diastolic dysfunction parameters, suggesting that increasing TSH levels may have a dose-dependent effect on cardiac performance [5].

The pathophysiological mechanisms linking SCH to LVDD include reduced expression of sarcoplasmic reticulum Ca^{2+}-ATPase (SERCA2), altered myocardial energy metabolism, increased systemic vascular resistance, and subtle myocardial fibrosis—all of which contribute to impaired ventricular relaxation [6]. Despite growing evidence, the clinical relevance of identifying LVDD in SCH remains controversial, and routine cardiac screening is not widely recommended.

This study intends to evaluate the occurence and grading of left ventricular diastolic dysfunction among patients diagnosed with subclinical hypothyroidism, given the high incidence of SCH and the possibility of early but silent cardiac involvement. Finding these correlations could help improve risk assessment and preventative therapy while highlighting the significance of regular cardiovascular screening in SCH patients.

Methodology

Study Design: This study was a retrospective observational study.

Study Setting: At the Rajarajeswari Medical College and Hospital in Bangalore, a tertiary care teaching hospital offering both inpatient and outpatient services, the study was carried out at the Department of General Medicine and Cardiology.

Study Duration: The study was carried out over a period of two years, from September 2023 to August 2025.

Participants: The study comprised 100 participants who had been diagnosed with subclinical hypothyroidism. These participants were identified through the hospital's medical record system based on thyroid function test results and clinical evaluation.

Inclusion Criteria

- Patients who are at least eighteen years old.
- Cases of subclinical hypothyroidism, which is characterized by elevated serum TSH and normal free T4 levels, either recently or previously diagnosed.
- Patients with available complete medical and echocardiographic records.

Exclusion Criteria

- Individuals with overt hypothyroidism, diabetes mellitus, hypertension, chronic renal disease, or known cardiovascular disorders.
- Patients on medications affecting thyroid function or cardiac status.
- Incomplete or missing clinical or echocardiographic data.

Bias: To minimize selection bias, all eligible records within the defined time frame were reviewed without discrimination based on sex, age, or comorbidities unless they met the exclusion criteria. Observer bias was reduced by using pre-defined diagnostic criteria for diastolic dysfunction and independent verification by two physicians.

Data Collection: The hospital's electronic medical records system was used to retrieve patient data. Demographic information, thyroid function tests, and echocardiographic results—more especially, those measuring diastolic function via the E/A ratio, E/e' ratio, left atrial volume index, and deceleration time—were all included in the data.

Procedure: Using their previous echocardiograms, patients with subclinical hypothyroidism were retrospectively assessed for left ventricular diastolic dysfunction. Patients were categorized into normal or different grades of diastolic dysfunction based on the interpretation of the echocardiographic parameters using the American Society of Echocardiography (ASE) guidelines.

Statistical Analysis: Software for statistical analysis and data compilation (SPSS) version 23.0 was used. For continuous variables, descriptive statistics were displayed as mean ± standard deviation, and for categorical variables, as percentages. Using the independent t-test for continuous variables and the chi-square test for categorical data, correlations between diastolic dysfunction and subclinical hypothyroidism were assessed. Statistical significance was defined as a p-value of less than 0.05.

Results

Out of 100 patients with subclinical hypothyroidism, 68 (68%) were females and 32 (32%) were males. Participants ranged in age from 22 to 70 years, with a mean age of 47.6 ± 11.2 years. The majority (58%) were aged between 41–60 years.

Table 1: Age and Gender Distribution of Participants

Demographic Variable	Frequency (n=100)	Percentage (%)
Gender		
Male	32	32%
Female	68	68%
Age Group (years)		
18–30	12	12%
31–40	18	18%
41–50	30	30%
51–60	28	28%
>60	12	12%

Female predominance was observed, and most patients were in the 41–60 years age group.

Among the 100 patients, 42% were found to have evidence of (LVDD) based on echocardiographic parameters. Out of these, 31 patients had Grade I dysfunction (impaired relaxation), 9 had Grade II (pseudonormal pattern), and 2 had Grade III (restrictive filling).

Table 2: Grading of Diastolic Dysfunction

Diastolic Function Grade	Number of Patients	Percentage (%)
Normal	58	58%
Grade I (Mild)	31	31%
Grade II (Moderate)	9	9%
Grade III (Severe)	2	2%

Grade I dysfunction was most commonly observed, indicating early myocardial relaxation abnormalities in subclinical hypothyroid patients.

The mean TSH level in patients with normal diastolic function was 6.8 ± 1.4 mIU/L, whereas it was significantly higher in patients with diastolic dysfunction (9.2 ± 2.1 mIU/L, $p < 0.001$).

Table 3: Comparison of TSH Levels Between Patients with and Without LVDD

Group	Mean TSH (mIU/L) ± SD	p-value
No Diastolic Dysfunction	6.8 ± 1.4	
Diastolic Dysfunction	9.2 ± 2.1	<0.001

Diastolic dysfunction was substantially correlated with higher TSH levels, indicating a gradual effect of thyroid disease on cardiac relaxation.

Females had a higher occurrence of diastolic dysfunction (47.1%) than males (31.2%), although the difference was not statistically significant ($p = 0.09$).

Table 4: Gender-wise Occurrence of Diastolic Dysfunction

Gender	Diastolic Dysfunction Present	Percentage (%)	p-value
Male	10 out of 32	31.2%	
Female	32 out of 68	47.1%	0.09

Female patients showed a higher occurrence of LVDD, though not reaching statistical significance.

Table 5: Mean Echocardiographic Parameters in Study Groups

Parameter	Normal Function (n=58)	LVDD (n=42)	p-value
E/A ratio	1.3 ± 0.2	0.8 ± 0.1	<0.001
E/e' ratio	7.6 ± 1.1	11.4 ± 2.3	<0.001
Left Atrial Volume Index	28.4 ± 4.7	36.2 ± 5.1	<0.001
Deceleration Time (ms)	190 ± 28	240 ± 36	<0.001

Patients with LVDD had significantly altered echocardiographic parameters consistent with diastolic impairment.

Discussion

One hundred patients with subclinical hypothyroidism participated in this retrospective analysis, a significant proportion—42%—were found to have (LVDD) based on echocardiographic evaluation. The majority of these patients exhibited

Grade I dysfunction (31%), suggesting early myocardial relaxation abnormalities, while smaller subsets had more advanced stages, namely Grade II (9%) and Grade III (2%), indicating pseudonormal and restrictive filling patterns, respectively.

The study population had a marked female predominance (68%), and most participants were middle-aged (41–60 years). This aligns with known trends, as subclinical hypothyroidism is more prevalent in women, particularly in middle age. Despite being more common in women (47.1%) than in men (31.2%), diastolic dysfunction was not statistically significant ($p = 0.09$). Nevertheless, the gender trend may indicate heightened cardiovascular sensitivity to thyroid dysfunction in females.

Crucially, patients with diastolic dysfunction had significantly higher TSH levels (mean 9.2 ± 2.1 mIU/L) than those without (mean 6.8 ± 1.4 mIU/L), with a p-value < 0.001. This lends credence to the idea that a larger thyroid hormone imbalance, even in the subclinical range, can affect cardiac function, specifically myocardial relaxation, in a detectable way. Further analysis of echocardiographic parameters confirmed these findings. Patients with LVDD showed a reduced E/A ratio, increased E/e' ratio, larger left atrial volume index, and prolonged deceleration time—all hallmarks of diastolic dysfunction. The statistically significant differences ($p < 0.001$) in these indices between the two groups reinforce the Correlation between subclinical hypothyroidism and early cardiac dysfunction.

Overall, the findings indicate that a considerable proportion of patients with subclinical hypothyroidism have asymptomatic diastolic dysfunction, underscoring the need for early cardiac assessment even in the absence of overt hypothyroid symptoms or cardiovascular disease. Routine echocardiographic screening may be beneficial for timely identification and intervention to prevent progression to overt heart failure.

Recent evidence has consistently shown a significant Correlation between subclinical hypothyroidism and (LVDD). In a cohort study involving 60 SCH patients and 30 healthy controls, echocardiographic assessment revealed statistically significant reductions in early diastolic filling velocity (PE), PE/PA ratio, and Ei/Ai ratio in SCH patients. Despite preserved ejection fraction, SCH patients demonstrated marked diastolic dysfunction, highlighting the condition's subclinical cardiac impact [7].

Similarly, a study from a South Indian tertiary care center found that 72.2% of SCH patients had LVDD compared to only 30.5% of euthyroid controls. Notably, increased isovolumetric relaxation time and septal E/e' ratios, along with reduced mitral E wave deceleration time, were significant markers of dysfunction [8]. Another case-control study showed a 34% occurrence of LVDD in SCH women aged 20–50 years, with higher rates among those with elevated TSH levels (8–10 μU/L), further reinforcing the TSH-diabetic dysfunction link [9].

A large-scale study involving over 26,000 participants demonstrated that SCH was independently associated with LVDD, particularly among individuals with low T3 levels, suggesting that T3 may play a more central role in cardiac diastolic function than previously thought [10]. Parallel findings in a population-based cohort also revealed impaired left atrial reservoir and conduit strain in SCH individuals, supporting its Correlation with subclinical cardiac dysfunction [11].

In prospective research with 105 SCH patients, advanced echocardiographic indicators such global longitudinal strain (GLS) and myocardial performance index (MPI) were investigated. Using tissue Doppler and GLS characteristics, it was discovered that the existence of a presystolic wave (PSW) was an independent predictor of subclinical LV failure, proving its diagnostic utility [12].

Several interventional studies evaluated the potential reversibility of LVDD with levothyroxine therapy. One randomized trial showed that 25–50 μg/day levothyroxine administered over one year improved key echocardiographic indices such as mitral E/A ratio, septal E′ and lateral E′ velocities, and normalized diastolic function in 17 of 40 patients [13]. Another study reported that all 28 patients with grade 1 diastolic dysfunction reverted to normal following thyroxine replacement, emphasizing the therapeutic value of early intervention [14].

High-sensitivity C-reactive protein (hs-CRP) was found to be strongly linked to LVDD in SCH patients in a follow-up study that concentrated on lipid and inflammatory biomarkers. Although lipid profile correlations were weaker, the findings suggest that low-grade inflammation may mediate cardiac dysfunction in SCH [15]. Lastly, a cross-sectional analysis confirmed structural cardiac remodeling in SCH patients, showing significantly increased LV mass and wall thickness even in the absence of overt hypothyroid symptoms [16].

Conclusion

According to this study, people with subclinical hypothyroidism have a substantial incidence (42%) of left ventricular diastolic dysfunction, with significant correlations between elevated TSH levels and impaired diastolic parameters. Early echocardiographic screening in these patients may aid in the timely detection and management of subclinical cardiac involvement, potentially preventing future cardiovascular complications.

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